

REMARKS

Claims 1, 9, 15 and 17-23 are in this application and are presented for consideration. By this amendment, Applicant has amended claims 1, 9 and 15.

Claims 1, 9, 15 and 17-23 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Choo et al. (U.S. 6,407,360) in view of Okamoto (U.S. 5,502,001) and Xuan (U.S. 6,308,898).

Applicant has discovered the problem that manufacturing costs are significantly increased as the result of blind cracks not being properly formed in brittle material substrates. Applicant has solved this problem by providing a device and a method that checks the condition of the blind crack while the brittle material substrate is being scribed. This advantageously ensures that the blind crack is properly formed before the brittle material substrate is broken. This is significant in the present invention because it significantly decreases the amount of substrates that are not properly broken along the blind crack. This drastically decreases production costs since more brittle material substrates are properly broken along the blind crack, which significantly decreases manufacturing waste and time. The device and method of Applicant's invention comprises a determination unit that includes a window comparator that determines whether a level of light received after reflecting the light on a blind crack is between predetermined thresholds V_{ref1} and V_{ref2} and the window comparator provides this determination as a window comparator output. Applicant has attached an example of a window comparator as Annex 1. The determination unit determines whether the blind crack is normal or defective based on the window comparator output. The blind crack is determined to be

defective when the level of light is greater than a threshold V_{ref1} or less than a threshold V_{ref2} . The blind crack is determined to be a normal blind crack when the level of light is between the thresholds V_{ref1} and V_{ref2} . The prior art as a whole fails to disclose such features or blind crack shape state determining advantages.

Choo et al. discloses a method of cutting a glass substrate using a laser cutter 206. The laser cutter 206 moves toward the glass substrate 100 such that the rotating blade 264 of the pre-scriber 260, the cutting laser beam 228, and the crack detecting laser beam 237 are aligned with the scribe line 120 defined by the cutting key 20. The rotating axis 262 of the pre-scriber 260 is moved clockwise such that the rotating blade 264 is positioned at the cutting start edge of the scribe line 120 of the substrate 100. The rotating blade 264 rotates at a specific RPM to form a cutting start groove at the start edge of the scribe line 120. After forming the cutting start groove, the rotating blade 264 stops and the rotating axis 262 returns to the original position by moving counterclockwise. The substrate 100 is heated by irradiation of the cutting laser beam 228 of the first laser 220 and is rapidly cooled down by coolant sprayed from the spraying nozzle 244 to generate a crack along the scribe line 120. A crack detecting laser beam 237 is irradiated onto the crack generated, following the coolant sprayed along the scribe line 120. When the crack detecting laser beam 237 is irradiated onto the crack, a part of the crack detecting laser beam 237 is reflected by the crack. A sensor disposed on a wall of a focusing lens housing 296 of the second laser 290 detects an amount of the light reflected from the crack, transforms the detected light amount signal into an electric signal and transfers the electric signal to the microprocessor 400. The microprocessor 400 perceives a propagation path 120'

of the crack generated from the input electric signal and compares the propagation path 120' of the crack with the pre-stored path of the marked scribe line 120. By comparison of the two paths, it is determined whether the propagation path 120' of the generated crack deviates from the marked scribe line 120. When the propagation path 120' of the crack corresponds with the path of the marked scribe line, cutting is continued.

Choo et al. fails to teach and fails to suggest the combination of a determination unit that determines a condition of a blind crack based on an output of a window comparator wherein the window comparator determines whether a light receiving signal is within predetermined level of light receiving thresholds. Choo et al. merely discloses a microprocessor 400 that detects whether a propagation path 120' is on a predetermined scribe line 120. However, the microprocessor 400 of Choo et al. does not detect the condition of a blind crack as featured in the present invention. Compared with Choo et al., the comparator means of the present invention determines whether a level of light receiving signal obtained from a light reception element is between predetermined thresholds V_{ref1} and V_{ref2} to provide a comparator means output. A determination unit of the present invention determines a condition of a blind crack based on the comparator means output such that it is determined whether the blind crack is in a defective condition or in good condition. This advantageously allows the state of the blind crack to be quickly determined during the scribing operation so that the scribing operation can be stopped immediately if the blind crack is found to be defective. This advantageously increases manufacturing and product efficiency since brittle substrate materials are not further processed once it is determined that the blind crack is improperly formed during

the scribing operation. Choo et al. fails to disclose such manufacturing cost savings advantages since Choo et al. does not teach or suggest a determination unit that includes a window comparator that extracts the state of the light receiving signal from a light reception element and compares it to predetermined thresholds. In fact, Choo et al. does not disclose a polarizing beam splitter as claimed. As such, the prior art as a whole fails to establish a prima facie case of obviousness since the cited prior art reference does not teach or suggest important features of the claimed combination.

Okamoto discloses a method for forming a fine light beam having a size that is smaller than a theoretical limit that is determined by a wavelength of light and characteristics of an objective lens. A beam distribution shifter having two light transmission regions is disposed between a source of light and an objective lens. A phase shifter is provided on one of the two light transmission regions to divide the light passing through the beam distribution shifter into two light fluxes having phases opposite to each other. The two light fluxes are focused through the objective lens to form a fine light beam having a size smaller than the theoretical limit determined by the wavelength of the light and characteristics of the objective lens due to destructive interference between the two light fluxes.

Okamoto fails to teach or suggest the combination of a determination unit including a window comparator wherein the determination unit determines the condition of the shape state of a blind crack based on an output of the window comparator. Okamoto merely discloses a light beam-forming apparatus 10 having a beam expander 11, mirrors 12, 13, 14, half-mirrors 15, 16, lenses 17, 18 and an objective lens 5 that are arranged on an optical path that links a

source 1 of light of the optical system to a sample 2. However, the arrangement of lens and mirrors of Okamoto does not include a window comparator that determines whether the level of a light receiving signal from a light reception element is within predetermined light receiving thresholds. Compared to Okamoto, the determination unit of the present invention determines whether a blind crack has been formed and if the blind crack is normal or defective based on the output from the window comparator. This advantageously increases manufacturing and product efficiency since the brittle substrate materials are broken properly as a result of checking whether each blind crack has been properly formed. Compared with the present invention, Okamoto only directs the person of ordinary skill in the art toward a light beam-forming apparatus, but fails to direct the person of ordinary skill in the art toward a determination unit including a comparator that determines whether a level of reflected light from a blind crack is within predetermined light receiving thresholds V_{ref1} and V_{ref2} as featured in the present invention. As such, the prior art as a whole fails to establish a prima facie case of obviousness since the cited prior art references do not provide any teaching or suggestion for each feature of the claimed combination.

Xuan discloses a laser head 200 for delivering laser light beams to opposite surfaces 211 and 212 of substrate 210 mounted on spindle 220 rotated about axis 221 in the direction indicated by arrow A. A laser delivery system comprises an electronic shuttle 230 linked to attenuator 240 and optical coupling 251. Polarizer 280 is connected to beam splitter at one end and optically linked to fiber optic cables 261 and 262 via optical couplings 252. Fiber optic cable 261 is optically linked to microfocusing lens 292 via optical coupling 253. As substrate

210 rotates, sub-laser light beams 301 and 302 impinge upon surfaces 211 and 212, respectively, forming a uniform pattern of precisely formed protrusions. The system employing fiber optic cables are maintained in position employing clamps 263, 264, 265.

Xuan fails to teach and fails to suggest the combination of a determination unit that determines a condition of a blind crack including a window comparator that determines a shape state of a blind crack. At most, Xuan discloses sub-laser light beams 301 that form a pattern on surfaces 211 and 212. However, there is no determination unit disclosed in Xuan that determines the condition of a blind crack based on an output of a window comparator as featured in the present invention. Xuan merely is concerned with laser texturing a magnetic recording medium, but fails to direct the person of ordinary skill toward addressing the problem of determining the condition of a blind crack in a brittle material substrate prior to breaking the brittle material substrate. Compared with Xuan, a window comparator determines whether a light receiving signal from a light reception element is within predetermined thresholds. According to the present invention, a determination unit determines a condition of a blind crack based on the window comparator output. This advantageously allows the scribing operation to be halted if the blind crack is defective so that the brittle material substrate is not broken along the scribed line. This saves significant manufacturing costs since more brittle material substrates are properly broken along properly formed blind cracks, which significantly reduces the amount of waste and manufacturing time. Xuan does not disclose such manufacturing efficiency and waste reducing advantages since Xuan only teaches forming a pattern on surfaces 211 and 212 using lasers, but Xuan is completely void of any teaching or suggestion for a

determination unit having a window comparator as featured in the present invention. As such, the prior art as a whole takes a different approach and fails to establish a prima facie case of obviousness since the cited prior art references do not teach or suggest essential features of the claimed combination. Accordingly, Applicant respectfully requests that the Examiner favorably consider claims 1, 9 and 15 as now presented and all claims that respectively depend thereon.

Favorable and further consideration on the merits is requested.

Respectfully submitted
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Attached: Annex 1 Sheet

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